

NEW STRATIGRAPHICALLY SIGNIFICANT FORAMINIFERA FROM THE DINANTIAN OF GREAT BRITAIN

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ABSTRACT. Four new genera of foraminifera are described. Two of these, *Gigasbia* (Earlandiidae) and *Bibradya* (Endothyridae), are diagnostic guides to the Asbian Stage, and a third, *Melatolla* (Endothyridae), characterizes Brigantian strata. *Biorbis*, the fourth new genus is of uncertain affinities and has been found in strata of Arundian to Brigantian age. *Criborespira denticulata* sp. nov. is confined to Asbian strata.

THIN-SECTION studies of Lower Carboniferous (Dinantian) limestones in several regions of Great Britain have revealed many undescribed taxa of smaller foraminifera. This paper describes six new species, five belonging to new genera, which have a restricted stratigraphical range within the British Dinantian.

Unless stated otherwise all registration numbers quoted are of thin sections in the collections of the Institute of Geological Sciences at Leeds. Grid references to the localities are in square brackets. Dimensions given in the descriptions represent the range observed in known specimens and may not be the maxima or minima attained by each taxon. This paper is published by permission of the Director, Institute of Geological Sciences (N.E.R.C.).

Family EARLANDIIDAE Brady, 1884

Genus GIGASBIA gen. nov.

Type species. *Gigasbia gigas* sp. nov.

Derivation of name. From *gigas* = giant (Latin) and Asbian (Dinantian Stage, of which this genus is characteristic).

Diagnosis. A very large, thick differentiated walled earlandiid, with a spherical chamber followed by a long straight cylindrical chamber.

Description. Test free. Wall calcareous, microgranular to granular. Outer layer of wall thin, dark, and finely microgranular, gradually coarsening to produce a thicker, more robust, less dense, granular inner layer. Innermost layer of spherical chamber thin, dark, and microgranular. Calcareous granules in wall of elongate chamber aligned parallel to the peripheral curvature of the spherical chamber. Walls of cylindrical chamber parallel or slightly subparallel. Wall of spherical chamber not in contact with elongate chamber, tends to be uniformly microgranular and less differentiated than the rest of the test. Diameter of spherical chamber: external 420–670 μm , internal 280–500 μm . Maximum width of elongate chamber 580 μm . Maximum width of internal tube 250 μm . Maximum length observed 2000 μm (note that the large, elongate nature of this genus makes it difficult to find complete specimens in random thin sections. Probably none of those figured shows a complete specimen.)

Remarks. This genus is much larger than *Earlandia* Plummer, 1930, and also differs from it by having a more robust and clearly differentiated wall structure, alignment of grains in the wall, and a parallel aspect to both the internal and external portions of the wall.

Gigasbia gigas sp. nov.

Plate 54, figs. 1-5

Holotype. ARE 1194, early Asbian Stage, Potts Beck Limestone, 54 m below sandstone which occurs at the top of this formation, Groups Hollows [NY 6988 0827], near Newbiggin-on-Lune, Cumbria.

Description. As for the genus, only one species recognized.

Occurrence. This species has been found in most regions of the British Lower Carboniferous. It is quite common in Britain, though it has not been recorded elsewhere. To date the species has only been found in Asbian Limestones and tends to be more common in early Asbian strata, equivalent to the Potts Beck Limestone of Cumbria. The distinctive size and shape make it easy to recognize in thin section, and hence it is a useful guide fossil for the Asbian. The species is present in both basin and shelf facies.

Recorded occurrences include the following: Bc 3766s, Asbian, Alport Borehole [SK 1360 9105], Derbyshire, depth 1780-81 ft; Bk 4671, late Asbian, Hotwells Limestone, Ashton Park Borehole [ST 5633 7146], Bristol, depth 1928 ft; ARE 730, Asbian, Urswick Limestone, 12.5 m below top, Stainton Quarry [SD 2490 7280], Dalton-in-Furness, Cumbria; ARE 1102, Asbian, Urswick Limestone, 1 m above base, Old Park Wood Quarry [SD 3381 7750], Holker, Cumbria; ARE 1430, early Asbian, Strandhall shore [SC 2513 6870], Isle of Man; ARE 34, late Asbian, Urswick Limestone, 4 m above base, Trowbarrow Quarry [SD 4800 7575], Silverdale, Cumbria; LL 2157, early Asbian, Potts Beck Limestone, 78.21 m above base, Little Asby Scar [NY 6988 0827], near Newbiggin-on-Lune, Cumbria; KR 9998, late Asbian, Oxwich Head Limestone, 2 m above base, St. Govan's Head [SR 9668 9283] Pembrokeshire; ARE 1000, 1011, 1013, late Asbian, Oxwich Head Limestone, 4.5 m, 15 m and 17 m respectively, above base, Pwlldu Head [SS 570 863], West Glamorgan, South Wales; ARE 426, Asbian, Chee Tor Rock, 21 m above base, Hay Dale/Dam Dale [SK 1127 7781], Derbyshire.

Family ENDOTHYRIDAE Brady, 1884

Genus BIBRADYA gen. nov.

Type species. *Bibradya inflata* sp. nov.

Derivation of name. *Bi* refers to the bifurcating septa, *bradya* after H. B. Brady and intended also to emphasize its membership of the Subfamily Bradyininae.

Diagnosis. An endothyrid with bifurcating septa, inflated final chambers and cribrate aperture.

Description. Test free. Wall thin, microgranular or very finely granular, dense and compact, increasing slightly in thickness with growth. Septa thick, blunt, swollen, more robust than surrounding wall and clearly bifurcating close to their origin. Sutures well defined. Chambers rounded and slightly swollen, increasing rapidly in size in the final whorl, rendering the latter the most important part of the test. Coiling irregular. Initial $2\frac{1}{2}$ volutions arranged in a tight, irregular-coiling formation which is totally encompassed by the highly inflated final whorl; 5-6 chambers in final whorl. Aperture cribrate.

EXPLANATION OF PLATE 54

All figures $\times 75$.

Figures 1-5. *Gigasbia gigas* gen. et sp. nov. 1, holotype, ARE 1194, early Asbian, Potts Beck Limestone, 54 m below sandstone horizon, Groups Hollows, Cumbria. 2, LL 2157, early Asbian, Potts Beck Limestone, 78.21 m above base, Little Asby Scar, Cumbria. 3, ARE 1102, Asbian, Urswick Limestone, 1 m above base, Old Park Wood Quarry, Cumbria. 4, ARE 1000, late Asbian, Oxwich Head Limestone, 45 m above base Pwlldu Head, Gower, South Wales. 5, ARE 730, early Asbian, Urswick Limestone, 12.5 m below Woodbine Shale, Stainton Quarry, Cumbria.

Figures 6, 7. *Bibradya inflata* gen. et sp. nov. 6, holotype, ARE 335, early Asbian, Tandinas Limestone, level 9, Tandinas Quarry, Anglesey. 7, ARE 403, Asbian, Chee Tor Beds, 2 m above base, Hay Dale/Dam Dale section, Derbyshire.

Fig. 8. *Cribospiria denticulata* sp. nov., holotype, ARE 335, early Asbian, Tandinas Limestone, cycle 9, Tandinas Quarry, Anglesey.



Remarks. The most characteristic feature of this genus is the bifurcating septa. The chamber shape and wall structure are endothyroid. The cribrate aperture and bifurcating septa distinguish it from *Plectogyransopsis*. The overall shape and coiling are very similar to those of *Janischewskina*, which has a thin, delicate wall in the initial whorls and a very inflated final whorl. The septal structures of *Janischewskina* are distinguished by their complex sutural apertures. *Bibradya* is also similar in coiling and shape to *Cribrospira*. Mamet (1973, pl. 7, fig. 27) figured as *Janischewskina* sp. an example with only one truly bifurcating septum, the other septa being normal or showing only initial signs of bifurcation (see Pl. 55, fig. 4), and this form would appear to be an early morphological praecursor of *Bibradya*. The example was found in Mamet's Zone 13 (= Asbian) which is at the same level to which *Bibradya* is confined in Britain. It would appear that *Bibradya* may have evolved from *Cribrospira* (or *Holkeria*) and is possibly a predecessor of *Janischewskina* characteristic of the Brigantian.

Bibradya inflata sp. nov.

Plate 54, figs. 6, 7

Holotype. ARE 335, early Asbian Stage, Tandinas Limestone, Tandinas Quarry, SH 5800 8200, Anglesey.

Derivation of name. Latin *inflata*, referring to the inflated chambers and final whorl.

Description. Wall thin, microgranular. Septa thick, blunt and clearly bifurcating. Sutures well defined. Chambers rounded and swollen, increasing rapidly in size in final whorl. Coiling irregular, initial $2\frac{1}{2}$ whorls totally covered by inflated final whorl. 5-6 chambers in final whorl. Aperture cribrate. Diameter 560-650 μ m. Wall thickness 20-30 μ m. Height of final chamber 300 μ m.

Occurrence. The species has been found in several British localities. It is confined to Asbian strata and is especially characteristic of the early Asbian. Records of the species include, in addition to the holotype, the following: ARE 1244, late Asbian, Oxwich Head Limestone, 15 m above base, Mumbles Head [SS 6318 8725], Gower, South Wales; ARE 1000, late Asbian, Oxwich Head Limestone, 4.5 m above base, Pwlldu Head [SS 570 863] West Glamorgan, South Wales; ARE 403, Asbian, Chee Tor Limestone, 2 m above base, Hay Dale/Dam Dale section [SK 1234 7662], Derbyshire.

Bibradya grandis sp. nov.

Plate 55, figs. 1-3

Holotype. Bk 4213, Asbian Stage, depth 1844 ft 11 in, Hotwells Limestone, Ashton Park Borehole, ST 5633 7146, near Bristol, Avon.

EXPLANATION OF PLATE 55

All figures $\times 75$ unless otherwise stated.

Figs. 1-3. *Bibradya grandis* sp. nov. 1, holotype, Bk 4213, Hotwells Limestone, Ashton Park Borehole, depth 1844 ft 11 in. 2, ARE 335, Tandinas Limestone, cycle 9, Tandinas Quarry, Anglesey. 3, Bk 4229, late Asbian, Hotwells Limestone, Ashton Park Borehole, Avon, depth 1850 ft 9 in.

Fig. 4. *Janischewskina*? Reproduced from Mamet 1973, pl. 7, fig. 27. Mamet Zone 15 (Asbian).

Fig. 5. *Melatolla whitfieldensis* gen. et sp. nov., holotype, ARE 503, early Brigantian, Single Post Limestone, 1 m above base, Whitfield Gill, near Askrigg, Yorkshire.

Fig. 6. *Melatolla* sp. Reproduced from Conil *et al.* 1980, pl. xix, fig. 12. PS 2136 (IGS Edinburgh collection), late Asbian, Archerbeck Beds, Archerbeck Borehole, Canonbie, Dumfriesshire, depth 1860 ft.

Fig. 7. *Melatolla* sp. $\times 70$. Reproduced from Rozovskaia, 1963, pl. v, fig. 6. Venev-Mikhailov, USSR.

Figs. 8-12. *Biorbis duplex* gen. et sp. nov. 8, LL 2130, early Asbian, Potts Beck Limestone, 12.00 m above base, Little Asby Scar, Cumbria. 9, ARE 46, early Asbian, Urswick Limestone, 8 m below recognized base of section, Trowbarrow Quarry, near Silverdale, Cumbria. 10, LL 2151, early Asbian, Potts Beck Limestone, 45.5 m above base of bed i, Little Asby Scar, Cumbria. 11, holotype, ARE 691, late Asbian, Knipe Scar Limestone, 24 m above base, Little Asby Scar, Cumbria. 12, HR 3440, early Brigantian, Oxford Limestone, Spittal Shore, near Berwick, Northumberland.



STRANK, Dinantian foraminifera

Derivation of name. Latin *grandis* referring to the large size of this species.

Description. Wall microgranular or very slightly granular. Septa very thick, robust, blunt, swollen, and bifurcating in most cases. Sutures moderately defined. Chambers mildly rounded, increasing rapidly in size in the final whorl, rendering the latter the most important part of the test compared with inner, irregularly coiled whorls. Coiling irregular. Final whorl covers the whole test. 5–7 chambers in final whorl. Aperture probably cribrate. Diameter 850–1100 μm . Height of final chamber up to 600 μm .

Occurrence. To date this species has only been found in Asbian strata. Records of the species include, in addition to the holotype, the following: Bk 4209, Bk 4213, and Bk 4333, from depths 1844 ft 11 in, 1850 ft 8 in and 1867 ft respectively, late Asbian, Hotwells Limestone, Ashton Park Borehole [ST 5633 7146], near Bristol; ARE 335, early Asbian, Tandinas Limestone cycle 9, Tandinas Quarry [SH 8200 5800], Anglesey.

Remarks. Larger than *B. inflata*, with thicker, more robust septa and higher inflation of final whorl.

Genus CRIBROSPIRA von Möller, 1878

Cribrospira denticulata sp. nov.

Plate 54, fig. 8

Holotype. ARE 335, early Asbian Stage, Tandinas Limestone, cycle 9, Tandinas Quarry, SH 5800 8200, Anglesey.

Derivation of name. Latin *denticulata*, meaning set with small teeth (referring to regular tooth-like septa).

Description. Test free. Wall granular, calcareous. Septa short, relatively thick, usually pointed, slightly irregular in shape but often at right angles to the chamber wall. Sutures become better defined with growth. Chambers not very swollen, slightly rounded, increasing rapidly in size in the final half-whorl, giving the aperture a raised appearance. Coiling initially irregular, with final whorl totally encompassing the inner coiled portion. 7–8 chambers in final whorl. Aperture cribrate. Diameter 450–650 μm . Thickness of wall up to 20 μm . Height of final chamber up to 250 μm .

Remarks. A closely related form belonging to the genus *Cribrospira* is found occurring in the same horizon as *Bibradya*. Since it is very similar to *Bibradya* in some sections, this new species is described here in order to avoid confusion. This species differs from *B. inflata* in not having bifurcating septa, and from *C. pansa* in having differently shaped septa, and being larger in size.

Occurrence. ARE 335, early Asbian, Tandinas Limestone cycle 9, Tandinas Quarry [SH 8200 5800], Anglesey; ARE 984, late Asbian, Danny Bridge Limestone, 117 m below top of section, River Clough [SD 7000 9119], near Sedbergh.

Genus MELATOLLA gen. nov.

Type species. *Melatolla whitfieldensis* sp. nov.

Derivation of name. Greek *melas*, meaning black, dark; and Latin *tollere* to lift or raise.

Diagnosis. A partially uncoiled endothyrid with extremely heavy supplementary deposits in the form of floor coverings and spines in the final whorl. Final aperture cribrate.

Description. Test free. Wall calcareous, dark, microgranular. Septa rounded *in continuum* with chamber shape with slightly inflated ends. Sutures deep and well defined. Chambers inflated and well rounded. Coiling regular, planispiral in final whorls—may be initial oscillations. Terminal raising of whorl height into an incoiled portion of varying development. Supplementary deposits very well developed in final whorl. Floor coverings rapidly increasing in thickness and density to form massive, robust, blunt spines in the final chambers. Aperture cribrate in uncoiled portion. Maximum observed diameter of coiled portion 715 μm . Nine chambers in final whorl.

Remarks. This genus differs from *Endothyra* in that it is partially uncoiled and cribrate, from *Rectoparaendothyra* in being more robust and having a larger coiled section, and from *Mikhailovella* in being much larger, and in having very well-developed supplementary deposits. It also differs

from *Corrigotubella* in not having a thick, granular, agglutinated wall, and from *Endothyranella* in having prominent basal deposits, and being more massive. One form in the literature which appears to belong to this genus is that figured by Rozovskaia (1963, pl. v, fig. 6) as *Mikhailovella gracilis* (Rausser-Chernoussova, 1948); the well-developed supplementary deposits (see Pl. 55, fig. 7) distinguish this specimen from true *M. gracilis* (Rausser-Chernoussova, 1948). The only other example figured is that in Conil *et al.* (1980) (see Pl. 55, fig. 6) described as gen. nov. In USSR the genus occurs in the Mikhailov/Venev horizon, correlated with the Brigantian Stage of Britain.

Melatolla whitfeldensis sp. nov.

Plate 55, fig. 5.

1980 gen. nov. Conil and Longerstaey in Conil, Longerstaey and Ramsbottom, pl. xix, fig. 12.

Holotype. ARE 503, early Brigantian, Single Post Limestone, 95 cm above base, Whitfield Gill, SD 9350 9204, Askrigg, North Yorkshire.

Diagnosis. *Melatolla* with well-developed supplementary deposits, more robust than *M. sp.* of Rozovskaia, the only other known form.

Occurrence. This species has been recorded so far only in Britain, where it is rare. Recorded occurrences, in addition to the holotype, include: PS 2136 (IGS Edinburgh collection), late Asbian, Archerbeck Beds, depth 1260 ft, Archerbeck Borehole [NY 416 782], near Canonbie, Dumfriesshire; KR 6744, late Asbian, Danny Bridge Limestone, 160 m below top of section, River Clough [SD 7000 9119], near Sedbergh. HR 3077, Brigantian, Smiddy Limestone, River Eden, Janny Wood [NY 7830 0370], near Kirkby Stephen, Cumbria.

Family uncertain

Genus *BIORBIS* gen. nov.

Type species. *Biorbis duplex* sp. nov.

Derivation of name. From *bi*, meaning double, and *orbis*, meaning ring or circle.

Diagnosis. A double concentric sphere with an outer wall of large diameter enclosing an inner wall of smaller dimensions.

Description. Test free. Wall calcareous, granular to microgranular, consisting of two annuli of different diameters, one enclosing the other. The outer ring has a dark microgranular external layer which decreases in density to a granular appearance towards another dark, dense, microgranular layer on the internal margin of this wall. The nature of the internal ring is identical although the microgranular layers are often not quite so well developed. Cross sections through the test are often circular or ellipsoidal. Diameter of circular sections 250–350 μm . Thickness of outer wall 40–50 μm . External diameter of inner ring 120–180 μm . Thickness of inner wall 20–40 μm .

Remarks. There are several possibilities for the overall shape of this test. It could be a spherical object, in which case it should be classed with the calcispheres. The ellipsoidal sections could then be explained as being squashed specimens. Alternatively, the rings could be cross sections through an elongate, cylindrical 'Earlandia'-type form, in which case they would be classed as Earlandiidae. However, none of the corresponding elongate sections of this has ever been found, although examples similar to these figured are quite common. In addition, the wall structure is differentiated into layers, whereas the small earlandiids described originally by Plummer (1930) have a uniform wall structure and texture. The external dark layer is similar to that found in *Gigasbia* gen. nov., but the internal microgranular layer is missing in the cylindrical portion, and the dimensions of *Gigasbia* are much larger. Vachard (1980, p. 14, fig. 10) figured a form with three rings inside one another which he stated was formed of three specimens of *Earlandia* wedged inside each other. His figure is not good enough to see the wall structure but it looks uniformly microgranular, unlike these samples. It seems unlikely, therefore, that these are cross sections through tubes of *Earlandia*.

and they can be described as a new genus. Differs from *Eovolulina* Antropov 1950 in that the latter has a less differentiated and complex wall structure.

Biorbis duplex sp. nov.

Plate 55, figs. 8–12

Holotype. ARE 691, late Asbian, Knipe Scar Limestone 24 m above base [NY 6988 0827], Little Asby Scar, near Newbiggin-on-Lune, Cumbria.

Derivation of name. *duplex*, referring to the double wall of the shell.

Description. As for the genus, only one species being known.

Occurrence. This species occurs commonly in strata ranging from Arundian to Brigantian in age. Occurrences include: Arundian—KR 3330, Embsay Limestone, Embsay Beck SE 006 537, Yorkshire. Asbian—LL 2139 and LL 2151, from 5.89 and 45.5 m above the base of the Potts Beck Limestone at Little Asby Scar; ARE 36 and ARE 23, 2 m and 15 m respectively above base of section (below Woodbine Shale), Trowbarrow Quarry [SD 4800 7575], Silverdale, Cumbria. Brigantian—HR 3440, Oxford Limestone, Spittal Shore [NU 0120 5090], near Berwick, Northumberland.

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